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SUNSTROKE, OR PARALYSIS OF THE HEART BY HEAT.

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THE number of cases of sunstroke which occurred in the Second Corps of the Army of the Potomac on the marches of the last summer's campaign, and the diversity of opinions among our medical officers respecting its nature and treatment, decided me to seek the earliest opportunity of bringing the currently received pathology of the disease to the test of experiment. As the result of a large number of observations on animals subjected to an elevation of temperature in various modes, and which presented a series of symptoms very closely allied or identical with those of sunstroke as I had seen it, and as I found it described by careful observers, I have reached the conclusion that the disease results from the direct action of heated blood upon muscular tissue, and that its fatal termination is owing to a paralysis of the heart from the same cause.

By publishing my experiments I hope to secure greater interest in accurate observation of the disease and greater unanimity respecting its rational treatment. They may be divided into five classes:—

1st. Those in which warm-blooded animals were subjected to an artificial elevation of temperature, the symptoms they manifested observed, and *post-mortem* appearances noted.

2d. Those in which artificial respiration was practised as soon as the animal became comatose or the pupil became contracted.

3d. Those in which blood heated to 120° Fahr. was injected into the veins of the animal from which it had been drawn, or in which the blood of an animal perishing from the disease produced by heat was injected into the veins of an animal of the same species.

4th. Those in which it was proved that the muscular system of an animal could be paralyzed by heat while its nervous system was left intact.

5th. Experiments on muscular contractility as affected by heat.

Class 1st.—The following may be taken as a type of this class.

A rabbit is placed in a glass jar, or bell glass, of sufficient capacity for free respiration during the experiment. A thermometer is suspended from the cover of the jar, and the jar immersed in hot water. The temperature of the interior of the jar is raised above 115°, but not allowed to rise above 120°. Soon after this heat has been reached, after a period varying with the size of the animal, the animal becomes restless and respires more rapidly; the bloodvessels of the ears enlarge, and their pulsations (which are almost imperceptible on a healthy rabbit) are distinctly felt. The heart beats more rapidly. At length the animal utters a few cries, and becomes comatose. The pupils are dilated, but in a few minutes become contracted. When contraction of the pupil has ensued, the animal is removed from the heated medium. He lies motionless, but the eyelids close on touching the conjunctiva. The ears continue hot. Their bloodvessels are still full, their pulsations forcible and rapid. In a variable period (from a quarter to a half hour after contraction of the pupils) the bloodvessels cease to be distended; the ears and mucous membranes, where visible, take a bluish tint; respirations diminish in frequency. Occasionally life is terminated by an attack of convulsions, but oftenest ceases gradually. When the thorax is opened, the ventricles of the heart are found rigidly contracted, or become so in five or ten minutes, both auricles distended with blood and manifesting fibrillar movements. Neither brain nor lungs are congested. The venæ cavæ are filled with dark blood, which is alkaline and coagulates rapidly. The cut surface of the ventricles is acid to litmus paper. Under the microscope the blood is normal, but the muscular fibres of the heart have lost their transverse striations. Rigor mortis comes on between one and two hours after death. The rigid heart becomes relaxed and quite flaccid in a few hours. The odor of putrefaction is very soon manifest, although the temperature of the laboratory is not above 60°.

Various animals were immersed in water at 115°, held by the back of the neck, the head above the surface. The larger animals, if allowed to respire the free air, panted violently, but resisted the fatal influence of the heated medium. Small animals, as mice and rats, soon perished; the mucous membrane of the mouth, at first redder than natural, became livid; the respirations gradually ceased, with gasping. In a rat that had struggled violently against efforts to secure him and was immersed in water at 120°, the mucous membranes became pale in five minutes, and in five minutes more all the muscles of the body became rigidly and permanently contracted. In these experiments, a thermometer introduced immediately after death into the thoracic and abdominal cavities did not rise above 115°; it often gave one or two degrees below that temperature. Distension of the stomach by a full meal, and loss of blood, hastened the fatal termination. A litter of kittens served for these comparative experiments.

Class 2d.—In these experiments the trachea was opened, a tube inserted and artificial respiration kept up as soon as the respiratory movements began to fail. Life was not prolonged by this proceeding.

Class 3d.—In a cat that had died in heated air with all the symptoms of sunstroke, the thorax was opened and blood drawn from the vena cava ascendens with a hypodermic syringe. This was immediately injected into the jugular vein of another cat previously etherized. Not the slightest toxic symptom was manifested.

Class 4th.—The reflex actions manifested by animals apparently moribund from the effects of heat presented a decided contrast to those of narcotism or exhaustion of the nervous system. But the effects of heat on cold-blooded animals served to show more plainly its comparative integrity. On account of the sluggishness of their circulation, the heart is the last organ to feel the influence of a heated liquid. The circulation in the web of a frog's foot is temporarily arrested by a temperature of 115°. When a frog is thrown into water at that temperature all the muscles of the body become rigid in one or two minutes. If a limb does not share in the immersion it will remain unaffected, or only that portion of the limb which is immersed becomes rigid. In frogs immersed to the thighs in water at 120° even, and kept exposed to its influence some time after the anterior extremities and the muscles of the trunk have become rigid, irritation of the spinal cord in the cervical region will cause the muscles of the hind legs to be convulsed. The thigh of a frog, with the sciatic nerve projecting, immersed in water at 120°, will become rigid, but the foot will be convulsed on irritation of the projecting nerve. These experiments show plainly that the nervous system is less sensitive than the muscular to the influence of a high temperature.

Class 5th.—The more violent the activity of a muscle the lower the temperature at which it will pass into a state of rigidity. This was proved in several ways. A frog with one sciatic nerve divided was thrown into convulsions with strychnia. The hind legs, separated from the trunk, were immersed simultaneously in heated water. When the limb which had been convulsed had become rigid, the other was removed from the water quite flaccid. The hearts of reptiles, which beat long after removal from the body, were immersed in heated water at a temperature just sufficient to arrest their pulsation. If in this condition they were irritated and caused to beat, they immediately became rigidly contracted.

The cut surface of a muscle in an animal killed by section of the medulla oblongata is not sensibly acid; that of a muscle made rigid by heat is decidedly acid. The muscles of a frog tetanized by strychnia are hardly more acid than in the natural state; those made rigid by heat are decidedly acid. The bloodvessels of the ear of a rabbit rendered comatose by heat could not be made to contract by galvanism or immersion in ice-cold water. The non-striated muscular fibre of the arterioles seemed to have lost its power of contraction, or it was at least too debilitated to resist the pressure of the blood communicated from the dilated arteries below; but the peristaltic action of the intestines is well marked in an animal dying from the influence of heat. The pupils of a frog, which contract after death, are dilated widely when the eye, removed from the orbit, is immersed in a liquid at 115°.

Effects of Elevation of Temperature on the Human System.—Under the names of sunstroke, coup de soleil, ictus solis, heat apoplexy, heat asphyxia, sun fever, erethismus tropicus, thermohæmia, thermic fever, a well-marked affection has been described, not to be confounded with cerebral congestion, apoplexy, meningitis, pulmonary apoplexy, epilepsy, or simple exhaustion and prostration occurring during the prevalence of excessively hot weather and favored by a high temperature, which have often been mistaken for or have complicated the disease in question.

Causes.—The greatest number of cases are the result of muscular exercise in the sun in excessively warm weather; but the direct action of the sun is merely a favorable condition, it is by no means a necessary cause. Mr. T. E. Dempster, in giving a description of the disease as it occurred in the English Army in Bengal in 1849, says:—"During the first few marches a number of men fell victims to that fearful disease [sunstroke]; the fatal seizures usually occurred about 3 o'clock in the morning, and long before the sun was above the horizon." Mr. H. S. Swift, in an article on sunstroke published in the *New York Journal of Medicine* in 1854, describing the disease as seen in the New York Hospital, gives the following:—"Eleven cases were attacked one morning in the laundry of one of our principal hotels; several were brought to us from a sugar refinery," "and we had the opportunity of comparing their symptoms and lesions with those who became exhausted after laboring in the sun, but were unable to satisfy ourselves of any distinction." The direct heat of the sun, which made a gun-barrel unpleasantly hot to the touch, was the most frequent condition of the disease as it occurred in the Army of the Potomac last summer. I had occasion to notice its unusual prevalence during marches under a cloudless sun, before a thunder storm. Such was the morning on which the Second Corps broke camp near Morrisville and marched to the Rappahannock in the advance to Culpepper Court House and the Rapidan.

Foreigners from the north of Europe, and particularly those of recent arrival in the country, are peculiarly liable to the disease. Their skins are too thick and sluggish for our high and variable temperature. Diseases of the abdominal viscera, as diarrhœa, and a febrile state particularly, predispose to the affection.

Symptoms.—The disease, when fatal, presents, usually, two well-marked stages. It is ushered in by sudden pain in the head, weakness, præcordial distress, vertigo and insensibility. This last is so sudden that the term "stroke" is properly applied to the onset. The insensibility deepens into coma, with dilatation of the pupils. The pulse, however, is both full and frequent. Respiration is hurried. The mucous membranes are red and dry, the skin dry and hot; both of a deeper color than natural. The first stage occupies the principal portion of the time. The average duration of the fatal cases is in all only four hours. This is succeeded by a stage of collapse. The pupils become contracted, or may remain dilated; respiration becomes stertorous, with moaning; the pulse feeble, remaining frequent; the mucous membranes become livid, the skin cool. Life disappears gradually, with occasional gasping respirations and tracheal râles; or death may take place suddenly, with an attack of convulsions.

The disease may present, at the onset, the symptoms of the second stage, the first having been wanting, or imperfectly marked, and the approach of death is then speedy. Contracted pupils and moaning respiration are signs of a fatal termination.

The milder cases, which recover, present the symptoms of the first stage only. When the momentary or short stupor passes by, the panting and manifestations of præcordial distress are often pitiable. Thirst is excessive, but deglutition and articulation difficult. One half of the cases, as seen in the hospitals of New York and Philadelphia, are fatal. In the army, the proportion of fatal cases among those falling out of the ranks with the symptoms of sunstroke, is certainly much less.

Pathological Anatomy.—I have not witnessed a *post-mortem* examination in a case of sunstroke. The speedy decomposition of the body renders the opportunity of making valuable *post-mortem* observations transient. Prof. Pepper, of the University of Pennsylvania, found the heart dilated and flaccid. Dr. H. S. Swift states that "the *post-mortem* appearances, though of a negative character, are precisely opposite to those found in congestion of the brain or apoplexy produced by insolation." Dr. Horatio C. Wood, in the *Am. Journal of the Med. Sciences* for October, 1863, reports a number of *post-mortem* examinations made from one to two hours after death. He notes that the heart was rigidly contracted, but as rigor mortis of that organ usually ensues within that period. there could have been nothing remarkable about the contraction, except its rigidity and completeness. He notes the absence of cerebral and pulmonary congestion, and the liquidity of the blood.

Physiology.—I can find only three modes in which endeavors have been made to explain the physiology of sunstroke:—through the nervous system, through the lungs, and through the blood. The theories of cerebral apoplexy may be neglected. Jas. Ranald Martin, F.R.S., in the London *Lancet* for 1859, thus resumes an argument respecting the nature of the disease:—"Extreme venalization of the blood, acute congestion at first, proceeding to passive congestion and narcotism of the lungs, heart and brain." The following is a quotation from the article referred to by Dr. Swift. His theory is in close accordance with the facts of the disease. "There are many points of resemblance in the appearance of those who have died from the effects of heat, and cases reported of death from lightning. Does the heat produce death by destroying the 'vital principle,' as Hunter supposed was the effect of lightning? Does it produce some chemical change in the blood itself, so that it can no longer subserve the purposes of innervation, or does it produce its effects primarily on the nervous system? This is the most plausible theory. The vital powers, already enfeebled by fatigue and the heat of the atmosphere, are unduly stimulated. The natural balance of the circulation is destroyed, and the heart contracts with a 'morbid activity.' The lungs are engorged with blood and the heart labors to overcome the increased obstacle, until at length it is exhausted by this 'morbid activity,' and passive congestion takes place in the capillaries throughout the body."

Dr. H. C. Wood attributes the disease to a poisonous property acquired by the blood, and suggests the name of thermic fever or thermo-hæmia. I commenced my experiments with a prejudice in favor of this theory, but was soon compelled to abandon it, or to regard the only poisonous property of the blood to be its elevated temperature. The remarkable contraction and rigidity of the heart directed my attention immediately to the muscular system. They have proved that a temperature of the blood below 115° Fahr. is sufficient to destroy life in vertebrate animals of all classes; that a temperature between 115° and 120° is sufficient to cause rigid contraction and paralysis of muscles, whether connected with or separated from the body of the animal; that the more violently a muscle is made to contract, the lower the temperature at which it will become paralyzed; and that a disease is produced by heat in the lower animals presenting symptoms almost identical with those of sunstroke, in which the heart is found rigid immediately after death.

The cases in which Prof. Pepper found the heart flaccid were those in which rigidity had disappeared from the rapidity of *post-mortem* changes; those in which Dr. Wood found the heart contracted are explicable from the time of the examination. That the blood rises in sunstroke to a temperature sufficient to produce muscular paralysis is proved by the fact that Dr. Dowler found a temperature of 112° in the axilla. The dilatation of the capillaries is explicable by the direct effect of the heated blood upon the muscular fibres of the arteries and arterioles. The cerebral symptoms, and the full and forcible pulse may also be due to this dilatation. Bernard found that section of the sympathetic nerve in the neck of a horse raised the column of mercury in a cardiometer placed on one of the small arteries of the neck sixty millimetres (about 2½ inches) above the level indicating the pressure in the artery before the section. The dilatation of the arteries must have been the only cause of this increase of pressure.

The effect of heated blood upon the heart is termed *paralysis* rather than exhaustion, because heat has been shown to have the power of directly paralyzing its muscular tissue, and because in sunstroke the first stage, or that of frequent and forcible contraction of the heart, is not an essential part of the disease. But whatever may be the value of my theory, the facts of experiment are such as I have recorded them.

A CASE OF FRACTURE OF THE THIGH IN AN INFANT SEVEN MONTHS OLD.

By David W. Cheever, M.D., one of the Surgeons at the Central Office of the Boston Dispensary.

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Chas. Henry Myers, between six and seven months of age, a puny child, but one neither scrofulous nor rickety, fell from his sister's arms to the floor, April 23d, 1864, and sustained a fracture of the right thigh. This was on Friday noon. On the following Monday he was brought to the Surgical Department of the Dispensary for treatment. It was now three days after the receipt of the injury, during most of which time he had cried and worried constantly. The right thigh was tilted up, forming a prominent angle at its middle, upwards and outwards. The femur was broken in the middle of its shaft. The limb was swollen to double the size of the other. The groin and perinæum were excoriated, on the injured side. Crepitation and tenderness on pressure were found over the prominent centre of the femur; and, as an additional sign, the greater trochanter did not describe its usual arc of a circle on rotating the femur from the knee. Following the position of flexion and abduction natural in the young infant, the thigh was more tilted up and outwards than is usual in the same injury in the adult; and the tendency to displacement arose mainly from the spasmodic action of the psoas and iliacus muscles. In this respect it resembled the adult fracture of the upper third of the femur, where the two intra-pelvic muscles just mentioned raise the upper fragment, and also rotate it outwards, from their insertion into the trochanter minor, which lies behind rather than inside the femur.

The indications for mechanical treatment were plain enough, but the difficulty of carrying them out was very great, on account of the infant's tender age. Treatment by a weight, by the double-inclined plane, or by counter-extension from the perinæum, were all obviously impracticable. In the applications which were made the first few days we had to pay regard to the swelling, the tenderness and the excoriation. Accordingly we were not surprised to find, on the fourth day after treatment was begun, or one week after the accident, that no attempt at union had taken place, although the swelling and soreness were much reduced.

Under these circumstances the following apparatus was applied; which, as it succeeded very well, we think it worth while to describe, although it is but a modification of the old appliance of Scultetus. A double flannel binder was carried around the waist and hips, and secured by pins, because this fastening admitted of the readiest re-adjustment, either to tighten or loosen it. Between its folds were made two pockets; one over the hip and side of the ilium, the other in front of the anterior superior spine of the latter bone. The bony prominences of the hip, knee and ankle were carefully cushioned with cotton-batting. A long outside splint, made from a shingle, extended from the outer pocket down to, and an inch below the foot. An inside splint, of gutta percha moulded on, reached from the upper third of the thigh to below the foot, and was then turned at a right angle, beneath the foot, to meet the long splint. Both the lateral splints were rolled in sheet lint, several thicknesses, before they were applied. Next, an anterior splint, of gutta percha, with the upper end curved upward over the abdomen, extended from the anterior pocket of the binder, down to just above the patella. This splint was meant to meet three indications:—1st, to press upon the projecting ends of the fracture, and compress the muscles of the anterior aspect of the thigh; 2d, to strengthen the apparatus at the upper third, where the inside splint was obliged to stop short on account of the perinæum and the excretions; 3d, to prevent the child from bending the pelvis on the thigh in trying to sit up, which it did quite forcibly until the abdomen brought up against the end of the anterior splint.[*] This splint was well padded over the fracture, and all the space in the groin was well filled in with cotton-batting, so that when the splint was bound down, very considerable pressure was exercised over the tendons of the psoas and iliacus, although, of course, their fleshy bellies were inaccessible within the pelvis.

The limb being now gently extended, the three splints were secured pretty firmly with a dry roller. Next a wet bandage was put on, and plaster of Paris rubbed in until it was quite thick and stiff. For obvious reasons, the perinæum and upper third of the inside of the thigh were left uncovered. After the stucco bandage had set and dried, the whole was varnished over with common shellac, or coach-maker's varnish, several thicknesses, to prevent the urine from soaking through the bandage.[†]

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[*] "Coulon" uses the simple "*appareil de Scultete,*" and applies a bandage across the chest, under the arms, to keep the child supine. But none of his cases were as young as this one.—*Des Fractures chez les Enfants,*" *par Coulon et Marjolin.*

[†] This excellent hint we owe to the history of a fracture of the thigh in a child of 23 months, admirably treated by Dr. John Green, and reported in this JOURNAL.

Finally, a strong and broad strip of cotton cloth extended from the flannel binder in front down to the anterior part of the thigh bandage, and was fastened by sewing. This secured the waistband from slipping up, or turning around, when the child twisted the trunk. Thus done up, the infant was left with the nates, perinæum and urinary apparatus free to be cleansed. As soon as the dressing was finished, crying ceased, and the child did not have another fit of worrying with its fracture during the duration of treatment. Meanwhile it underwent the cutting of two incisors, and a sore arm from vaccination, and yet gained in flesh and brightness. The mother had a good supply of milk, and the babe also received small quantities of iron. Occasionally a fresh coat of varnish was applied; but the urine did not pass through the bandages, and they were not changed until two weeks had passed.

One fortnight after its application, the apparatus was removed. The limb came out dry, clean and fresh, without an abrasion in any part. Union was good, the limb straight, and there seemed absolutely to be no shortening. Although we might expect firm union in fourteen days,* yet the child flexed and extended the leg so forcibly, that it was thought prudent to re-apply the apparatus. At the end of two weeks more it was finally removed, and the result was as perfect as could be desired.

The peculiar difficulties in treating a fracture of the thigh in so young an infant as seven months old, seem to be to secure immobility in so flexible and restless a subject; and to get moderate extension and pressure, without excoriation, either from this cause, or from the constant dribbling and infiltration of urine, and of the excretions of the bowels.

The apparatus above described allowed the child to be moved about, and even brought to the Dispensary occasionally on a pillow; thus relieving the tediousness—to a baby almost insupportable—of being confined in bed in one position.

As regards the youth of the subject, so far as we can find, the case is an unique one; and the result obtained seems to have justified the treatment pursued.

ON LIPOROCELE: ITS ANALOGY TO FATTY SERUM OF THE BLOOD AND TO CHYLOUS URINE.

By J. L. W. Thudichum, M.D., M.R.C.P. Lond.

Some time ago Mr. Fergusson operated upon a case of hydrocele, and withdrew a white, milk-like fluid. This fluid was brought under the notice of the Medical Society of London by Mr. Mason. At the request of the Society I undertook to further examine and report upon this singular pathological specimen. The substance of this report (which was delivered on April 4th, and accompanied with chemical demonstrations) is embodied in the following more extended observations.

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* Coulon gives the average of treatment at from twelve days to three weeks, in children's fractures.

The fluid was white, like milk, but in the thinnest layers was much more opaque than milk, showing that the particles causing the whiteness were much smaller than those in milk.

On standing, the fluid formed a *cream* on the top and a *sediment* at the bottom. The *cream* consisted, as seen by the microscope (420 diameters), of countless masses of very minute particles, having no resemblance to ordinary fat-globules in milk or animal tissues. Amongst the particles floated numerous roundish conglomerations of particles, pretty uniform in size and shape. They admitted of no further surmise as to their origin (no cell-structures being distinguishable) than that they were actually only particles of suspended matter which had coalesced by continued agitation.

The deposit consisted of crystalline masses, corresponding in appearance to what is usually described in text-books on animal chemistry as *margaric acid*. Closer examination with high powers distinguished two different kinds of crystals:—1. Very thin rhombic plates, distinguished from those usually formed by cholesterine in this, that their longest diagonal was about four times the length of the shorter one; while in cholesterine the relation of the longest diagonal to the shortest one is hardly 2:1. 2. Sheafs of needles, of which the crystallic shape could not be defined. They were lying in free bundles, or attached to the plates.

The fluid had an *alkaline reaction*. It had a slightly putrid odor, as it had been kept for some days, but the alkalinity was not a result of this otherwise very slight change. Mr. Mason had found it alkaline when fresh. Its total quantity was about 60 cubic centimètres.

By a qualitative examination, it was ascertained that it contained much albumen, fatty acids (but no neutral fats), phosphate of soda and chloride of sodium. Neither potash (searched for photoscopically) nor lime or magnesia could be found in the fluid from which albumen had been removed.

Twenty cubic centimètres of the fluid were shaken with an equal bulk of ether, and formed a permanent emulsion with this fluid. No ether appeared on the surface; the milky whiteness disappeared; the mixture, however, remained opaque. The quantity of ether being doubled, it separated easily after agitation, and was found to be of a yellowish color. It was drawn off by a syphon fixed in a flask by means of an air-tight cork. The extraction of ether was repeated six several times; the ethereal solution allowed to stand, in order to deposit some suspended watery particles, then decanted, and the ether distilled off in the water bath. The residue was extracted with absolute ether, and again evaporated and dried in a current of air in the water-bath. It consisted of a solid mass of fatty acids, entirely resolvable on boiling with solution of common phosphate of soda, in the form of an emulsion. The residue weighed 0·330 grammes. The milky hydrocele fluid, therefore, contained 1·65 per cent. of fatty acids.

The fluid from which fat had been extracted, and which yet contained ether in solution, was now mixed with absolute alcohol, which caused a copious precipitate of *albumen*. The magma was acidified by a little acetic acid, and in small portions gradually put into a dish on the water-bath to evaporate alcohol and ether, and effect the most complete precipitation of the albumen. The albumen was then extracted repeatedly with water, washed on the filter until neutral, and dried at 100° C. in the water-stove until its weight remained stationary. It weighed 1·695 grammes. The milky hydrocele fluid, therefore, contained 8·475 per cent of albumen.

The watery extract was evaporated in a platinum capsule, and dried at 100° C. It weighed 0·4162 grammes, equal to about 2·081 per cent. of the original fluid. It contained a little albuminoid substance and salts.

By ignition it lost 0·114 grammes, equal to 0·570 of the original fluid. There remained 0·3022 grammes, of fire-proof salts, fusible and white, containing carbonate and some charcoal, which was destroyed by nitric acid and renewed ignition. The ultimate residue of salts was equal to 1·511 per cent. of the original fluid.

In the solution of these salts acidified with nitric acid, nitrate of silver yielded a precipitate, which (dried) weighed 0.4014 grammes, corresponding to 0.099 grammes of chlorine; or 0·163 grammes of chloride of sodium, corresponding to 0.876 per cent. of the original fluid. There remained, by calculation, 0·696 per cent. for the phosphate of soda; but, as was anticipated from the presence of carbonate of soda, and the impairment of the reaction for phosphoric acid, a portion of this acid had been destroyed during ignition. As was determined, however, by precipitation with magnesia and ammonia, there still remained phosphoric acid enough to yield 0·5 per cent. of phosphate of soda in the original fluid. We are, then, justified in assuming its quantity to be equal to that found by calculation.

One hundred grammes of the milky hydrocele fluid, therefore, contained—

	Grammes.
Albumen	8·475
Fatty acids	1·650
Albuminoid matter	0·570
Chloride of sodium	0·815
Phosphate of soda	0.696
Total solids	12·206

The peculiarity of this fluid consists in the presence of free fatty acids in a state of most minute mechanical subdivision and suspension, aided by weak chemical affinities. This state of suspension is commonly termed "emulsion." When phosphate of soda in watery solution and some fatty acid are agitated together, or quicker when they are boiled, such an emulsion is always formed. Neutral fats, or the triglycerides of butyric, stearic, and palmitic acids, do not yield any emulsion on boiling with phosphate of soda, but remain floating on its surface, leaving the fluid perfectly clear. Oleic acid also refuses to enter into a phosphatic emulsion.

The emulsions of stearic and palmitic acids, although of an alkaline reaction, are such loose chemical compounds that, without the addition of any acid, the fatty acids can be extracted by means of ether.

While the phosphate of soda alone will form an emulsion with fatty acids, this property is much enhanced by the presence of albumen. This substance makes the suspension much more permanent. Whether the emulsion contain albumen and phosphate, or only phosphate, the fat can be equally well extracted by ether. Both emulsions, on standing at rest, allow the particles of fatty acid to collect at the top in the form of a cream; but this separation of the fatty acid is never complete except after addition of an excess of acid to the emulsion. But even acid phosphate of soda in the presence of albumen will retain some fatty acid in emulsion (chylous urine).

When to an emulsion of fatty acid with phosphate an excess of phosphate is added, and the fluid allowed to stand, the fatty acid compound collects at the top of the fluid, and the lower stratum of the fluid becomes clear. This separation of fatty acid compound by excess of salt must not be confounded with the formation of a cream of particles of fatty acid.

The occurrence of an emulsion, or of a white or yellowish milk-like fluid in the animal economy, under normal or pathological circumstances, justifies at once the surmise that there are present albumen, fatty acid, and phosphate of soda. On the other hand, a fatty substance which gives an emulsion with phosphate of soda is most probably stearic or palmitic acid. Neutral fats, butter, lard, suet, or human adeps, or fat from fatty livers or from cancerous tumors, do not yield the emulsion. The fat from fatty livers or cancerous tumors (speaking from a limited number of observations only) is consequently neutral fat; or if it contain acid fat, it must be the oleic acid.

The peculiar form of hydrocele containing milky serum has been occasionally observed at Paris, and there been termed "galactocele," or milk rupture. This name is not more inappropriate than that of hydrocele, or water rupture. But while it would be impracticable to attempt a substitution of serocele for hydrocele, it is perhaps practicable to avoid the term "galactocele," and to term cases of the above nature "liporocele," or "fatty serum rupture."

The next question which it is important to answer is as to *the* *origin* of this fatty serous fluid. The only probable source is of course the blood. But the circumstance which caused it to be exuded by the serous sheath of the testicles it is more difficult to surmise. The following experience will, however, assist us in forming an opinion on this subject.

Case of fatty or chylous serum of the blood, causing congestion of the brain and threatening paralysis.—A butcher had eaten a very large dinner with much fat meat, and in consequence had a few hours afterwards been attacked with severe congestion to the head, threatening apoplexy. He was bled to the extent of about sixteen ounces, had purgatives administered to him, and he recovered. After the blood had coagulated, the clot was found floating in a thick or turbid yellowish serum. About four ounces of serum were obtained and examined. Treated with ether the matter causing the turbidity dissolved, and, after distillation of the ether, was left in granular and oily particles. Boiled with phosphate of soda it formed a milky, thick emulsion. It was, therefore, mostly fatty acid. A second extraction with ether yielded some more, but yellow fat, the first having been white. Under the microscope the solid particles of the fatty matter consisted entirely of the balls of fine needles, commonly called margaric acid (stearic and palmitic acid). The fatty residue again dissolved in ether left some albuminous matter behind, which was also insoluble in alcohol. It was separated by filtration, and, after evaporation of the ether, drying under the air-pump, fusing in the water-stove, and drying over sulphuric acid, left 50·59 grains of fatty acids, being about 2·6 per cent. of the serum.

It has not yet been ascertained whether the fat taken with the food does normally undergo a separation into fatty acids and glycerine, so that we cannot say whether or not the presence of fatty acid in any portion of the blood is a regular occurrence or a pathological feature. But the following relations are possible:—

a. The presence of emulsed fatty acids in serum (of a vein of the arm, and consequently in a greater portion of the blood) is a normal occurrence. Presence of fatty acid beyond the normal quantity is, however, pathological, and causes the blood to stagnate in the capillaries, producing congestion and effusion.

b. The presence of emulsed fatty acids in the serum of the blood is of itself a pathological feature, and able to produce the symptoms of congestion and effusion.

c. In any case the presence of the fatty acids is preceded by their formation, and this formation may of itself be a normal or a pathological process. It may be so by its occurring in the wrong place, at the improper time, or the acid may persist improperly long without being further assimilated. It may, for example, having been imported into the blood by the chyle, pass through the pulmonary circuit, and be contained improperly in arterial blood, causing various kinds of congestion, but more particularly congestion in that typical form of blood and kidney disease which manifests itself by the secretion of so-called *chylous urine.*

It was the peculiar fatty matter of this kind of urine that first directed my attention to the importance of the distinction between neutral fats and fatty acids from a pathological and practical point of view. In my treatise on the "Pathology of the Urine," p. 240, I recorded that I had found the fatty matter of chylous urine to consist of oleic and margaric acid (the latter now commonly admitted to be a mixture of palmitic and stearic acids). When I had found the fatty serum above described, I studied the nature of chylous urine synthetically. I added some of the fatty serum to healthy urine, producing mixtures of various proportions of the ingredients, approaching them as nearly as possible in external appearance to natural specimens of chylous urine. It was impossible, either by the eye and the smell, or by microscopical and chemical analysis, to distinguish the artificial chylous urine from the pathological product. Chylous urine is urine containing an admixture of fatty serum: it is liporotic urine. Its abnormal ingredient is the same as the effusion in the orchideal tunic constituting liporocele.

Stearic and palmitic acid, combined with earthy bases, I have met with in human gall-stones (see Treatise on Gall-stones, p. 101). This occurrence deserves attention in connection with the subject of this article, on account of the circumstances that bile always contains some phosphate of soda. Supposing an emulsion of fatty acids to be formed by the liver, the supervention of abnormal acids and earthy salts would cause an insoluble precipitate of fatty acid with earthy base, while phosphate of earthy base might also fall down or remain dissolved, if the free acid be strong enough, and not allowed to stand at rest.

The emulging power over fatty acids of the phosphate of soda naturally contained in bile has given rise to the opinion that the bile was instrumental in assimilating the fats eaten with the food. But it is now certain that over neutral fats neither the bile nor phosphate of soda has any peculiar assimilating power. If digestion in the stomach produces any fatty acid (and it mostly seems to produce a little), it cannot be denied, but must be affirmed, that it will be chemically affected by the phosphate of the bile and that of the blood. It is, however, certain that the greatest amount of fat eaten reaches the chyle and the blood unchanged—that is, as neutral fat. If, then, it undergoes decomposition, it must take place somewhere in the circuit of the blood, and within that fluid.

Whatever may be the dependence upon or the connection with the presence of a phosphatic emulsion of fatty acids in the serum of the blood of congestion to the head, threatening apoplexy—congestion of a serous membrane, producing effusion of serum—and congestion of kidneys, producing an admixture of serum with a natural secretion,—it is certain that the information we possess justifies us in attributing great importance not only to the bearing of fat and fatty acids, but also to that of phosphate of soda, particularly in the presence of albumen. Hitherto the mineral substances of the animal economy have not met with that consideration in animal chemistry which we might justly believe them to deserve, seeing how essential they are to the completion of the life of plants. Those who have read the latest accounts of the experiments of Liebig on the growth of potatoes have been astounded to find that the want of one or two mineral ingredients of manure predisposed potatoes to be destroyed by the disease which is peculiar to them. The potatoes which grew in a bed containing all the mineral ingredients necessary for their growth were not only two or three times as fruitful as those which grew in a bed only partially manured, but they also exhibited no liability whatever to be invaded by the rot. May not the vine-disease find a similar explanation—say the mere want of potash in the soil? Does not this experience suggest to us the inquiry after the part which mineral matters take in the normal and diseased processes of the human economy?

In the walls of the stomach hydrochloric acid is produced, and carbonated soda in the blood travels towards the liver. The liver secretes a new combination, containing soda as its basic element. In the intestine the chlorine and sodium re-unite after a variety of intermediate conditions.

The food contains both soda and potash salts, but the economy of our bodies separates them in a marked manner. The flesh contains principally salts of potash; the blood, which everywhere nourishes the flesh, contains mainly salts of soda. In both, these different bases are mainly combined with phosphoric acid. But the blood contains also salts of potash, not only temporarily during a period, so to say, of conveyance, but, the phosphate at least, as an essential and permanent ingredient of the red corpuscles. The serum, on the other hand, contains no phosphate of potash whatsoever. Whatever intermediate conditions of compromise may exist, the above relations are always those of the equilibrium to which the economy returns.

The fluid of the liporocele, while containing albumen almost in the same proportion as common serum of the blood, and fatty acid and phosphate of soda, with chloride of sodium in proportions which may also occur in serum of the blood, further resembled the plasma of the blood by the absence of salts of potash. This absence was, perhaps, not an absolute freedom, but the quantity which analogy might lead us to expect was inappreciable, owing to the limited quantity of material; of course, had any been found it would have had its significance. The life and health of plants, as well as those of animals, are very clearly dependent upon conditions which operate with the smallest quantities of matter, or dependent upon those matters essential to life which are present in the smallest quantity.—*London Lancet.*

THE BOSTON MEDICAL AND SURGICAL JOURNAL.

BOSTON: THURDSAY, JUNE 2, 1864.

Annual Meeting of the Massachusetts Medical Society.—The annual meeting of our State Society was held on Wednesday, the 25th inst., at the hall of the Common Council in this city, and was attended by a goodly number of members from all parts of the State. Dr. John Mackie, of New Bedford, was chosen temporary chairman, and after the usual preliminary business the election of officers followed with the following result:—

President, Dr. A. A. Gould ; *V. President*, Dr. H. L. Sabin, Williamstown ; *Corresponding Secretary*, Dr. W. E. Coale ; *Recording Secretary*, Dr. C. D. Homans ; *Librarian*, Dr. J. C. White ; *Treasurer*, Dr. Francis Minot ; *Orator*, Dr. B. E. Cotting ; *Anniversary Chairman*, Dr. W. E. Coale.

Dr. Francis Minot, Treasurer of the Society, presented his annual report. The receipts for the year have been $14,673 69 ; the expenditures $14,232 37 ; leaving in the treasury $441 32. The present indebtedness of the Society is $2,207 40 ; and the value of fund and cash property is $31,130 49.

Dr. John Green, of Boston, read a paper on the substitution of straw for splints in cases of fracture.

Dr. Bowditch gave an eloquent eulogium on the late Dr. John Ware.

The Chair appointed the following delegates to other State societies:

New Hampshire.—A. B. Hall of Boston, Henry C. Perkins of Newburyport.

Maine.—George Fabyan of Boston, Jonathan Ware of Milton.

Vermont.—H. I. Bowditch of Boston, T. R. Boutelle of Fitchburg.

Connecticut.—George C. Shattuck of Boston, Calvin P. Fiske of Fiskedale.

R. Island.—H. W. Williams of Boston, Josiah Bartlett of Concord.

New York.—H. H. Childs of Pittsfield, David Miller of Pittsfield, C. T. Collins of Stockbridge.

New Jersey.—John Homans of Boston, B. E. Cotting of Roxbury.

Dr. John Ordronaux, of New York, addressed the Society on the condition of the medical profession in the city of New York. He gave an interesting account of the various hospitals and medical schools of the commercial metropolis, setting forth the great advantages which they afford for the training of students in medicine, and explained the action of the State with reference to the military exigencies of the present time, by which their regiments are now supplied with a body of competent surgeons, equal to any in the field. He paid a feeling tribute to the members of the profession who had fallen in the service of the nation, and closed by returning his thanks for the hospitality which Boston had extended to him now and heretofore, which he should long carry with him in his memory, as evidence of days well spent.

At the request of the Society, Dr. Ordronaux also gave his views, quite in detail, of the various provisions which should be made by the Government for the care and support of the numerous invalid soldiers which the war would leave upon their hands. He thought that the nature of our institutions and our government called for an entirely new system of arrangements for this purpose, and he proceeded to unfold several plans which seemed to promise favorably for the desired purpose.

At the close of Dr. Ordronaux's remarks, Dr. N. B. Shurtleff read the report of the Library Committee, which represented the library as in a thriving condition.

At 12 o'clock, Dr. J. M. Warren was introduced as the annual orator, and occupied about an hour in the delivery of a well-prepared address on the history of surgery for the past thirty years, during which period, he remarked, a long series of splendid discoveries had completely changed the whole aspect of medical science. Of these Dr. Warren gave a hasty review, stating that within the limits of his address it was impossible even to enumerate the improvements made. The collection of medical statistics, which formed a part of the labor of the age, was an important duty, and would add a valuable feature to our literature.

Dr. Warren concluded by fitting mention of the medical martyrs of the war, and a eulogy on the wise forethought of the Governor in establishing a rigid test of medical fitness for surgeons under his appointment.

By vote of the Society, Dr. Ordronaux was requested to reduce to writing his remarks on the treatment of disabled soldiers, in order that they might be incorporated in the records of the Society. Dr. O. expressed his willingness to comply with this request.

After a vote of thanks to Dr. Warren for his able address, the Society adjourned at 1½ o'clock, and the members and their guests repaired to the Revere House to partake of a collation.

At 2½ o'clock Dr. Henry J. Bigelow called the company to order in one of the private parlors of the Revere House, and welcomed them to the hospitality of the Society as follows:—

GENTLEMEN OF THE MASSACHUSETTS MEDICAL SOCIETY,—In behalf of the Committee of Arrangements, most of whom have had more experience than myself in directing the details of your anniversaries, I am requested to say, that with a view to promote the social enjoyment of this occasion, they have decided to omit the usual public speaking; and it has been ingeniously contrived that your unfortunate anniversary chairman should bring home to your conviction the wisdom of this decision, by detaining you at the present time from your dinner with a few remarks to be taken on an empty stomach. It was once the custom on the occasion of an assemblage like the present, that men should eat and drink until the whole system responded to the genial and harmonizing influences of kindly and comfortable feeling, and then the key-note of fellowship once sounded was echoed from every side in tones of glowing eloquence. Your own Medical Benevolent Society opens its pockets and warms the cockles of its heart over the social board, and the Humane Society of Massachusetts burns a great deal of good tobacco before it can vote a little bad tobacco smoke in the attempt to save a drowned man from dying. But the age of progress is upon us. The spirit of reform which has conjured the strength from your goblet holds this very night its solemn anniversary to conspire against the fragrant leaf; and unless you rally in defence of your rights, the progress of another year may refresh you with a speech before dinner with no dinner after the speech. Four years have elapsed since we assembled in this city. The bounteous hospitality of our western friends, who at its last anniversary entertained this Society among the laurel-covered hills of Berkshire, came to us like quails and manna after long fasting. We of this Society have had our private foe and our tedious litigation, and we like other litigants have gained a victory only when our finances were exhausted, starvation stared us in the face, and we had summoned to the field our reserved and chosen men.

Who could foretell when we were last here assembled, the terrible and wide-spread calamity, the sacrifice of precious life, the blood and carnage that, following in the track of a relentless civil war, should summon our brethren from their round of peaceful civic duty to staunch the life-blood of the country dripping like water on the field of battle. Striving to save the lives of others at the hazard of their own, one amputating at the shoulder-joint under the trees at Newbern while the branches torn by balls are falling upon the wound itself; another at the distant sanguinary field of Shiloh; others perhaps at this very moment hastening to the front to succor their bleeding countrymen upon the reeking soil of Virginia.

Shall we forget him who in the maturity of his years and the fulness of experience, came with the ardor of a stripling to the dissecting-room, that he might renew for the service of his country his long-forgotten skill; who in a few weeks sent home, as if in token of his earnest work, the cannon-ball that came red hot across the Potomac to fall in front of his tent, and who after months of invaluable service, died a victim to his indomitable perseverance;—or yet the bright memory of that pure and single-hearted youth who left behind the brilliant professional future of his home and a claim upon the regards of this community, inherited from one now, alas! no more, to minister that noble charity which is the freewill offering of a grateful people to their brothers battling and falling in their defence; who, when for a second time, from a conscientious conviction of duty, he repaired to the scene of strife, deprived by the exigencies of a siege of his rightful aid, fell a martyr to his noble single-handed efforts to relieve the sick and suffering of that gallant garrison.

Let us avow our gratitude to those who have labored faithfully at home; to the Medical Commission of Massachusetts, who have so well represented us in summer and winter, without other compensation than that which comes from a conscientious discharge of duty; and whose careful discrimination has gone far to determine the high professional standard of Massachusetts surgeons in the field. We are proud of the able and urbane administration of our Surgeon-General, emphatically the right man in the right place. And, lastly, we will not fail here to recognize our obligation to the eloquent statesman, who, amid the harassing daily toil of office, at a moment when the exigencies of the country allowed no relaxation of vigilance nor respite from official duty, yet found time to respond to the claims of our profession in the able, discriminating and high-toned address to the students last graduated in medicine. Posterity will not forget the man at the sound of whose clarion voice the gallant sons of Massachusetts mustered first in the field, wheeled into the front line, the vanguard of the great national army, and marched, like the men of Concord and Lexington, to vindicate their principles and their hereditary glory.

We meet to honor the festival of a Society second to none in the loyal devotion of its sons, and which for more than three quarters of a century has frowned in silent dignity upon all that was false to human knowledge, absurd in science or unworthy in individual action. We have yet among us one of those earlier members, to whose good influence and able guidance it owes most, and whose own life has been a witness to the spirit of truth and justice which conceived and nurtured our Society. From such ancestry we have received our escutcheon untarnished, and as we are living men, we will transmit it to our sons, unsoiled at least by any compromise with voluntary ignorance and error.

I offer you now and here a heartfelt welcome; you who have rallied on this occasion from every hill and plain and every valley of our noble State, from the Atlantic shore to the mountains of Berkshire; you who at home, hunted and persecuted like the early Christians, seek here a brief respite from your professional labors, heedless of the breathless messenger and reckless of the midnight alarum, once more to meet the old allies of years gone by, to initiate new friendships, and to extend to each other a warm and cordial greeting. We may not know or see every man the other, but we feel a mutual interest as fellow laborers in a common cause. To most of us it seems but yesterday that we subscribed the roll of membership and entered the hallowed precincts of medical freedom and equality, to gaze with reverence on the gigantic strife of the panoplied and well-instructed veterans who met in those glorious days to do annual battle over the by-laws of the Society; until, incited by the strife, we came to hope that somebody would tread on our particular toe that we might have our private wrongs to redress. Not until years had rolled by did we discover that the maturer fruit often lost something of its acidity, and that art, science, humanity, medicine itself, flourished better under the genial auspices of peace and liberal forbearance.

We have strode along the path of professional life, our eyes fixed on the friendly image of those who went before, watching them, as one by one they dropped below the horizon, until we find that we ourselves are standing under the zenith. Our advance from youth to age is but too palpable on the evidence around us. The beardless youth of yesterday, anxious about his daily bread, and bearing with complacent fortitude even the indisposition of his friends, now finds himself burdened with an overwhelming practice; and perhaps surrounded with a growth of sturdy saplings, is buttressed like a banyan tree into the very fabric of society; or perhaps has already watched with parental solicitude a tender flower led by a stranger from her father's fireside, and while he fondly mused, was startled from his reverie to find his young brow ornamented with the silver honors of a grandfather;—or more than one other has sent his first born to the battle-field and has bid him Godspeed, never again to look upon his living face. If it be permitted to us here respectfully and tenderly to lift the veil of private sorrow, we would render to such, all our gratitude and all our sympathy for those gallant, noble sons, who have fallen, sword in hand, fighting for our rights and for the cause of human liberty.

The great political cyclone, which in its gigantic whirl has made the South a desert, and which so lately threatened, before the autumn should have passed, to convulse even the steadfast North, may be, in God's great plan, but as a passing summer shower, to wash and purify this western hemisphere. May we not hope that when we meet again, though the sky may still be dark and the waters not yet dried up, we may see the clouds breaking and the horizon glittering with the beams of peace; and, high aloft, rolling and flashing in the new-born light, the flag of our fathers resplendent with every northern and with every southern star.

After music by the Germania band, who discoursed upon this occasion some of their best operatic selections, the chairman again rose and introduced His Excellency Governor Andrew, with the following words:—"It has been well said, that, 'Turbulent times bring forth great men.' We are honored to-day with the presence of one, who, elected during a time of peace, to the highest office in the Commonwealth, has since borne, with proud distinction to himself and to the State, her battle-flag, nobly vindicating its legend, 'Peace after victory and liberty.'"

Governor Andrew excused himself from a formal speech, not having had a moment's time for premeditation. Nevertheless, he could not refrain from responding to the compliment paid him by the chair—a compliment attributing to him higher merit than he had ever thought of attaining to. He was much indebted to the members of the Society for the support which they had given him. The confidence with which fathers and mothers sent their sons to the field was in a great measure owing to their faith in the skill of the surgeons sent out with the approval of members of this Society. He could claim but little credit for himself in making these appointments.

When Governor Andrew had concluded his remarks, the company were ushered into an adjoining room, and invited to partake of an excellent collation. After this had been satisfactorily disposed of, Dr. Bigelow called on Dr. O. W. Holmes, who read a fine poem in memory of the late Dr. John Ware and his son Dr. Robert Ware.

VITAL STATISTICS OF BOSTON.

FOR THE WEEK ENDING SATURDAY, MAY 28th, 1864.

DEATHS.

	Males.	*Females.*	*Total.*
Deaths during the week - - - - - - - - -	58	45	103
Ave. mortality of corresponding weeks for ten years, 1853—1863,	39.1	36.3	75.4
Average corrected to increased population - - - - -	00	00	82 86
Death of persons above 90 - - - - - - - - -	0	1	1

The list of publications received, &c., is deferred till next week.

DEATHS IN BOSTON for the week ending Saturday noon, May 28th, 103. Males, 58—Females, 45.—Accident, 1—apoplexy, 1—disease of the bowels, 1—inflammation of the bowels, 2—congestion of the brain, 1—disease of the brain, 2—bronchitis, 2—cancer, 2—consumption, 21—convulsions, 3—croup, 3—cyanosis, 1—debility, 2—diphtheria, 1—dropsy, 3—dropsy of the brain, 4—erysipelas, 2—remittent fever, 1—scarlet fever, 6—spotted fever, 1—typhoid fever, 2—hæmorrhage, 1—disease of the heart, 5—hip disease, 1—infantile disease, 2—injured at birth, 1—disease of the kidneys, 1—disease of the liver, 1—congestion of the lungs, 2—inflammation of the lungs, 5—marasmus, 2—measles, 1—old age, 3—paralysis, 1—pleurisy, 1—scrofula, 1—smallpox, 4—suffocated, 1—suicide, 1—syphilis, 1—unknown, 6.

Under 5 years of age, 42—between 5 and 20 years, 16—between 20 and 40 years, 21—between 40 and 60 years, 13—above 60 years, 11. Born in the United States, 74—Ireland, 22—other places, 7.